PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Gasification Technologies

02/2002

ADVANCED REFRACTORIES FOR GASIFIERS

CONTACT POINTS

Richard Dunst
Project Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0949
(412) 386-6694
Dunst@netl.doe.gov

Gary Stiegel
Product Manager
Gasification Technologies
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0949
(412) 386-4499
gary.stiegel@netl.doe.gov

CUSTOMER SERVICE

(800) 553-7681

WEBSITE

www.netl.doe.gov

Description

Current generation refractory and thermocouple materials used in slagging gasifiers employed in IGCC power systems have unacceptably short service lives, limiting the reliability and cost-effectiveness of gasification as a means to generate power. Premature refractory failure occurs as the result of the extreme environment inside an operating gasifier, where materials are attacked by residual ashes and corrosive gases at high temperature. As a result of these severe conditions, the best of the refractory liner materials available today have a predicted service life of no more than two years. Actual service lives tend to be shorter in duration.

Thermocouple life in a gasifier is even shorter than that of the refractory lining, with a typical service life ranging from 45 days to four months. As a result, long-term reliable temperature measurement within a gasifier is problematic, making process control difficult. Like the refractory lining, thermocouple failure is typically the result of exposure to the harsh operating environment inside the gasifier.

This project addresses the need for improved materials to contain and monitor gasification processes. The focus of the research is to identify the primary failure mechanisms of refractories and thermocouple assemblies in a gasifier environment, and based on that understanding, to design improved products for this application with a lifetime of at least three years.

Goals

The goals of the project are:

a) Identifying material failure mechanisms;

b) Identifying/developing materials that will extend the lifetime of primary refractory liners in slagging gasifier systems and shorten system downtime caused by refractory repair and maintenance; and,

c) Developing improved thermocouples/temperature-monitoring techniques.

Advanced Refractories for Gasifiers

Program Focus Areas

1.) Identify Modes of Failure in the Gasification Environment:

Gasifier materials research will investigate the mechanisms of material failure as a first step toward identifying/developing ways to extend the lifetime of primary refractory liners and thermocouple assemblies. In addition, this research will investigate ways to shorten system downtime caused by refractory maintenance by examining the feasibility of applying refractory repair techniques to gasifier systems.

The first objective in accomplishing these tasks will be to identify common material problems in gasifier systems and potential collaborators willing to conduct joint research. Critical tests that simulate material failure will be identified, or developed, and used as a means of selecting candidate materials for further testing. The appropriate test equipment matching the environmental conditions for gasification research will be set up and testing will be conducted. The results from these tests will be correlated with those of other laboratory tests and known results from industry.

2.) Develop Improved Refractories and Thermocouples for Gasification Environment:

Research on failure mechanisms will be the foundation for determining the required characteristics of refractory liner materials and will provide a roadmap for developing new or improved materials. The goal of liner material research will be to extend intervals between refractory relines and to develop repair materials that can be applied over existing materials to reduce liner material installation time and costs. Material research will consider developing high thermal conductivity materials that have better resistance to thermal cycling, as well as resistance to abrasion and slag corrosion. Materials for chemical and physical property evaluation will be fabricated by sintering or fusion or obtained from refractory producers.

An understanding of the failure mechanisms of thermocouples exposed to the gasifier environment will also provide guidance in developing thermocouple assemblies that can operate longer and more reliably under these conditions. In this case, attention will focus primarily on solutions that more effectively protect the thermocouple wires from exposure to the corrosive gasifier environment.

To facilitate the above activities and to ensure that this research produces results that are relevant to industry, this project will seek feedback through the Gasification Technologies Council from both gasifier manufacturers and gasifier operators. CRADAs will be negotiated with interested members of the GTC, as well as with the major refractory and thermocouple manufacturers serving the gasifier industry.

PROGRAM PARTICIPANTS

Arthur V. Petty
Materials Performance Division Chief
Albany Research Center
Albany, Oregon
(541) 967-5878
petty@alrc.doe.gov